Digital Speech Processing
HW3 Report

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1 Environment

1. Operating system

```
mmlin@mmlin-VirtualBox:~/Desktop/dsp_hw3$ cat /etc/os-release
NAME="Ubuntu"
VERSION="16.04.6 LTS (Xenial Xerus)"
ID=ubuntu
ID_LIKE=debian
PRETTY_NAME="Ubuntu 16.04.6 LTS"
VERSION_ID="16.04"
HOME_URL="http://www.ubuntu.com/"
SUPPORT_URL="http://help.ubuntu.com/"
BUG_REPORT_URL="http://bugs.launchpad.net/ubuntu/"
VERSION_CODENAME=xenial
UBUNTU_CODENAME=xenial
mmlin@mmlin-VirtualBox:~/Desktop/dsp_hw3$
```

2. Compiler

```
mmlin@mmlin-VirtualBox:~/Desktop/dsp_hw3$ g++ --version
g++ (Ubuntu 5.5.0-12ubuntu1~16.04) 5.5.0 20171010
Copyright (C) 2015 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

2 Execution

1. Bigram model

(1) Type “make clean” to remove the executables
(2) Type “make MACHINE_TYPE=i686-m64 SRIPATH=/home/ta/srilm-1.5.10 all “
(3) Type “make map” to produce ZhuYin-Big5.map
(4) Type
“make MACHINE_TYPE=i686-m64 SRIPATH=/home/ta/srilm-1.5.10 LM=bigram.lm run”, and the result files will be saved in directory of “result2”

2. Bonus-Trigram model

Be sure that the trigram language model exists in the directory.
“trigram_lm_filename” denotes the filename of the trigram language model in the directory.

In the Makefile, the section of the execution of mydisambig_tri using trigram model:

```
run_tri: $(OBJ_TRI) -loolm -ldstruct -lmisc
	$(CXX) $(LDFLAGS) -o $(TARGET_TRI) $^

	if [ ! -d "$(RESULT_TRI)" ]; then \
		mkdir $(RESULT_TRI); \
	fi

	@for i in $(shell seq 1 10) ; do \
		echo "Running trigram version $$i.txt";\
		./mydisambig_tri testdata/$$i.txt $(TO) $(LM_TRI) result3/$$i.tx
t;\
	done;
```

```
LM_TRI ?= trigram.lm
TARGET_TRI = mydisambig_tri
SRC_TRI = mydisambig_tri.cpp
OBJ_TRI = $(SRC_TRI:.cpp=.o)
RESULT_TRI = result3
```

(1) Type “make clean” to remove the executables

(2) Type “make MACHINE_TYPE=i686-m64 SRIPATH=/home/ta/srilm-1.5.10 all “
(3) Type “make map” to produce ZhuYin-Big5.map
(4) Type
“make MACHINE_TYPE=i686-m64 SRIPATH=/home/ta/srilm-1.5.10 LM_TRI=trigram_lm_filename run_tri”, and the result files will be saved in directory of “result3”

3 Discussion

1. Bigram model
The bigram probability should be handled when the character is the first character of the sentence (BigramProb(“<s>”, character)) and the last character of the sentence (BigramProb(character,</s>)). I insert the string “</s>” at the end of each sentence. And I also initialize the delta values in the viterbi algorithm using the bigram probabilities of (“<s>”, first_character).

2. Trigram model
(1) Runtime
To reduce runtime and prevent from dealing with redundant characters, before saving ZhuYin-Big5.map into data structures in the program, I filter some characters by determining whether their VocabIndex is Vocab_None and whether their unigram probabilities are larger than “-6”. If there is no condition of “unigram probabilities are larger than -6”, the run time of mydisambig using trigram model is:

```
real    5m40.845s
user    5m21.808s
sys     0m0.874s
```

And if filtering out the characters whose unigram probabilities are smaller than -6, the runtime can reduce to:

```
real    2m34.548s
user    2m20.291s
sys     0m1.861s
```

(2) Performance
It can be shown that using trigram model can achieve some improvements. This is the screenshot of the result of bigram model of testdate/8.txt:

<s> 面 對 著 不 同 赴 美 新 聞 的 容 祖 兒 是 否 令 她 成 長 </s>

And this is the screenshot of the result of trigram model of testdate/8.txt:

<s> 面 對 著 不 同 方 面 新 聞 的 容 祖 兒 是 否 令 她 成 長 </s>

Because the latter case has considered the trigram probability, the model can take the context of “不同” and “新聞” into consideration to determine the characters. Therefore, “方面” is more appropriate for the sentence than “赴美”.